ARCADIS
Infrastructure · Water · Environment · Buildings

ARCADIS U.S., Inc.
1004 North Big Spring Street
Suite 300
Midland
Texas 79701
Tel 432.687.5400
Fax 432.687.5401
www.arcadis-us.com

ENVIRONMENTAL

Douglas Crist, Project Manager
Corrective Action Team 2
VCP-CA Section
Remediation Division
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Subject:
Schlumberger Technology Corporation
Agreed Order of 7/13/94 (Dowell Midland Facility)
Midland Facility, Midland County
Solid Waste Registration Number: 33591
Regulated Entity Number: RN102157252
Customer Reference Number: CN600384481
Update of VOC Delineation February 2011

Date:
March 9, 2011

Contact:
Debrah S. Gann

Phone:
432-687-5400

Email:
Debbie.gann@arcadis-us.com

Our ref:
MT001075.0001

ARCADIS U.S., Inc.
TX Engineering License # F-533

Dear Mr. Crist:

On behalf of Schlumberger Technology Corporation, please accept this written update to the TCEQ regarding the groundwater sampling results for new monitor wells south of Interstate-20 down gradient of the Midland Project site.

Since the last semi-annual sampling in August 2010 under the Agreed Order (AO), ARCADIS has installed 6 new monitoring wells to complete the delineation investigation of the volatile organic compounds (VOCs). MW-34, MW-35, MW-36 and MW-37 are completed in the shallow zone of the aquifer. MW-37A is completed in the intermediate zone and MW-37B is completed in the deep zone of the aquifer. The results for MW-34, MW-35, MW-36 and MW-37B are *not detected* for all VOCs. For MW-37 and MW-37A, 1,1-dichloroethene (1,1-DCE) is 0.110 mg/L and 0.0057 mg/L, tetrachloroethene (PCE) is 0.026 mg/L and not detected, and trichloroethene (TCE) is 0.073 mg/L and 0.0046 mg/L, respectively. Figures 1, 2 and 3 demonstrate the extent of the impact for 1,1-DCE, PCE and TCE.

ARCADIS has prepared a work plan for the Air Sparge / Soil Vapor Extraction (AS/SVE) pilot test enclosed with this update letter for TCEQ's review. The area proposed as the location for the AS/SVE pilot test is depicted in Figure 1 within the

9236623

AS/SVE Work Plan. Before the AS/SVE pilot test can be performed, ARCADIS proposes one air sparge well (SAS-1) 10-feet east of MW-37, one soil vapor extraction test well (SVE-1), and three piezometers (SPZ-1, SPZ-2 and SPZ-3). Figure 1 from the AS/SVE Work Plan shows the layout of the wells in relation to the MW-37 location. Detail descriptions and figures of the well constructions are provided in the Drilling Work Plan.

Sincerely,

ARCADIS

Debrah S. Gann

Steven P. Tischer

Debrah S. Gann PG
Project Scientist

Steven P. Tischer
Site Evaluation & Remediation
Department Manager

Copies:
Du'Bois J. Ferguson
Rick Deuell
Janice Barber

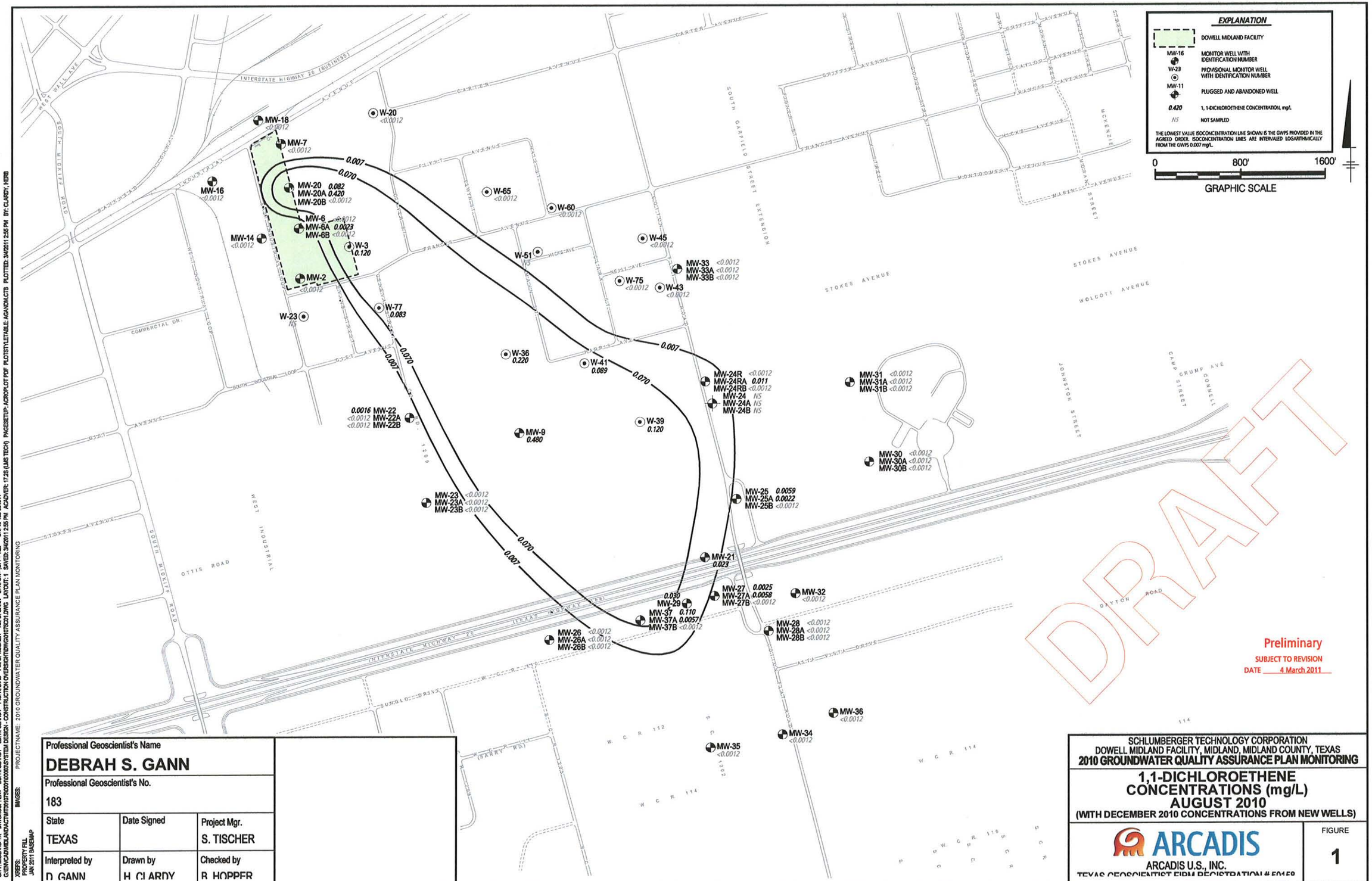
Attachments:

- Figures 1, 2 and 3 for 2010 Groundwater Quality Assurance Plan Monitoring
- AS/SVE Pilot Test Work Plan (with associated Figures 1, 2 and 3)
- Drill Wells for Air Sparge and Soil Vapor Extraction Pilot Test Work Plan (with associated Figures 1, 2, 3, 4 and 5)

XREFS:
PROPERTY FILL
JAN 2011 BASEMAP

IMAGES:

PROJECTNAME: 2010 GROUNDWATER QUALITY ASSURANCE PLAN MONITORING



Preliminary
SUBJECT TO REVISION
DATE 4 March 2011

Professional Geoscientist's Name		
DEBRAH S. GANN		
Professional Geoscientist's No.		
183		
State	Date Signed	Project Mgr.
TEXAS		S. TISCHER
Interpreted by	Drawn by	Checked by
D. GANN	H. CLARDY	R. HOPPER

SCHLUMBERGER TECHNOLOGY CORPORATION
DOWELL MIDLAND FACILITY, MIDLAND, MIDLAND COUNTY, TEXAS
2010 GROUNDWATER QUALITY ASSURANCE PLAN MONITORING

1,1-DICHLOROETHENE CONCENTRATIONS (mg/L) AUGUST 2010

(WITH DECEMBER 2010 CONCENTRATIONS FROM NEW WELLS)

ARCADIS
ARCADIS U.S., INC.
TEXAS GEOSCIENTIST FIRM REGISTRATION # 50158

FIGURE
1

EXPLANATION

- DOWELL MIDLAND FACILITY
- MW-16 — MONITOR WELL WITH IDENTIFICATION NUMBER
- W-23 — PROVISIONAL MONITOR WELL WITH IDENTIFICATION NUMBER
- MW-11 — PLUGGED AND ABANDONED WELL
- 0.120 — TETRACHLOROETHENE CONCENTRATION, mg/L
- NS — NOT SAMPLED

THE LOWEST VALUE ISOCONCENTRATION LINE SHOWN IS THE GWPS PROVIDED IN THE AGREED ORDER. ISOCONCENTRATION LINES ARE INTERVALED LOGARITHMICALLY FROM THE GWPS 0.005 mg/L.

0 800' 1600'

GRAPHIC SCALE

MW-18 <0.0023; MW-7 <0.0023; MW-16 <0.0023; MW-20 <0.0011, MW-20A <0.0023, MW-20B <0.0023; MW-6 <0.0025, MW-6A <0.0023, MW-6B <0.0023; MW-14 <0.0023; MW-3 0.029; MW-2 <0.0023; W-20 <0.0023; W-65 <0.0023; W-60 <0.0023; W-45 <0.0023; W-51 NS; W-75 <0.0023; W-43 <0.0023; MW-33 <0.0023, MW-33A <0.0023, MW-33B <0.0023; W-23 NS; W-77 0.027; W-36 0.120; W-41 0.081; W-39 0.063; MW-9 0.086; MW-24R <0.0023, MW-24RA 0.0049, MW-24RB <0.0023; MW-24 NS, MW-24A NS, MW-24B NS; MW-22 0.0072, MW-22A 0.0082, MW-22B <0.0023; MW-23 <0.0023, MW-23A <0.0023, MW-23B <0.0023; MW-25 0.0044, MW-25A <0.0023, MW-25B <0.0023; MW-21 0.0058; MW-29 0.0054; MW-37 0.026, MW-37A <0.0023, MW-37B <0.0023; MW-27 <0.0023, MW-27A <0.0023, MW-27B <0.0023; MW-32 <0.0023; MW-28 <0.0023, MW-28A <0.0023, MW-28B <0.0023; MW-26 <0.0023, MW-26A <0.0023, MW-26B <0.0023; MW-31 <0.0023, MW-31A <0.0023, MW-31B <0.0023; MW-30 <0.0023, MW-30A <0.0023, MW-30B <0.0023; MW-36 <0.0023; MW-34 <0.0023; MW-35 <0.0023

0.005; 0.050

INTERSTATE HIGHWAY 20 (BUSINESS); CARTER AVENUE; FLYNT AVENUE; FRANCIS AVENUE; HICKS AVENUE; NEILL AVENUE; HARRIS AVENUE; MONTGOMERY AVENUE; STOKES AVENUE; WOLCOTT AVENUE; DAYTON ROAD; ALTA VISTA DRIVE; SUNGLO DRIVE; COMMERCIAL DR; SOUTH INDUSTRIAL LOOP; WEST INDUSTRIAL LOOP; OTTIS ROAD; SOUTH GARFIELD STREET EXTENSION; WEST WALL AVE; SOUTH MIDKIFF ROAD; BLACKHEAD HIGHWAY; INDUSTRIAL AVENUE; WEST INDUSTRIAL AVENUE; SOUTH INDUSTRIAL AVENUE; EVANS STREET; GENEVA STREET; CLARK ROAD; COTTON FLAT ROAD; JOHNSTON STREET; CAMP CRUMP AVE; CONNELL STREET; W C R 112; W C R 114; W C R 115; INTERSTATE HIGHWAY 20 (TEXAS HIGHWAY 158); W C R 112 (BARRY RD)

DRAFT

Preliminary
SUBJECT TO REVISION
DATE 4 March 2011

Professional Geoscientist's Name		
DEBRAH S. GANN		
Professional Geoscientist's No.		
183		
State	Date Signed	Project Mgr.
TEXAS		S. TISCHER
Interpreted by	Drawn by	Checked by
D. GANN	H. CLARDY	R. HOPPER

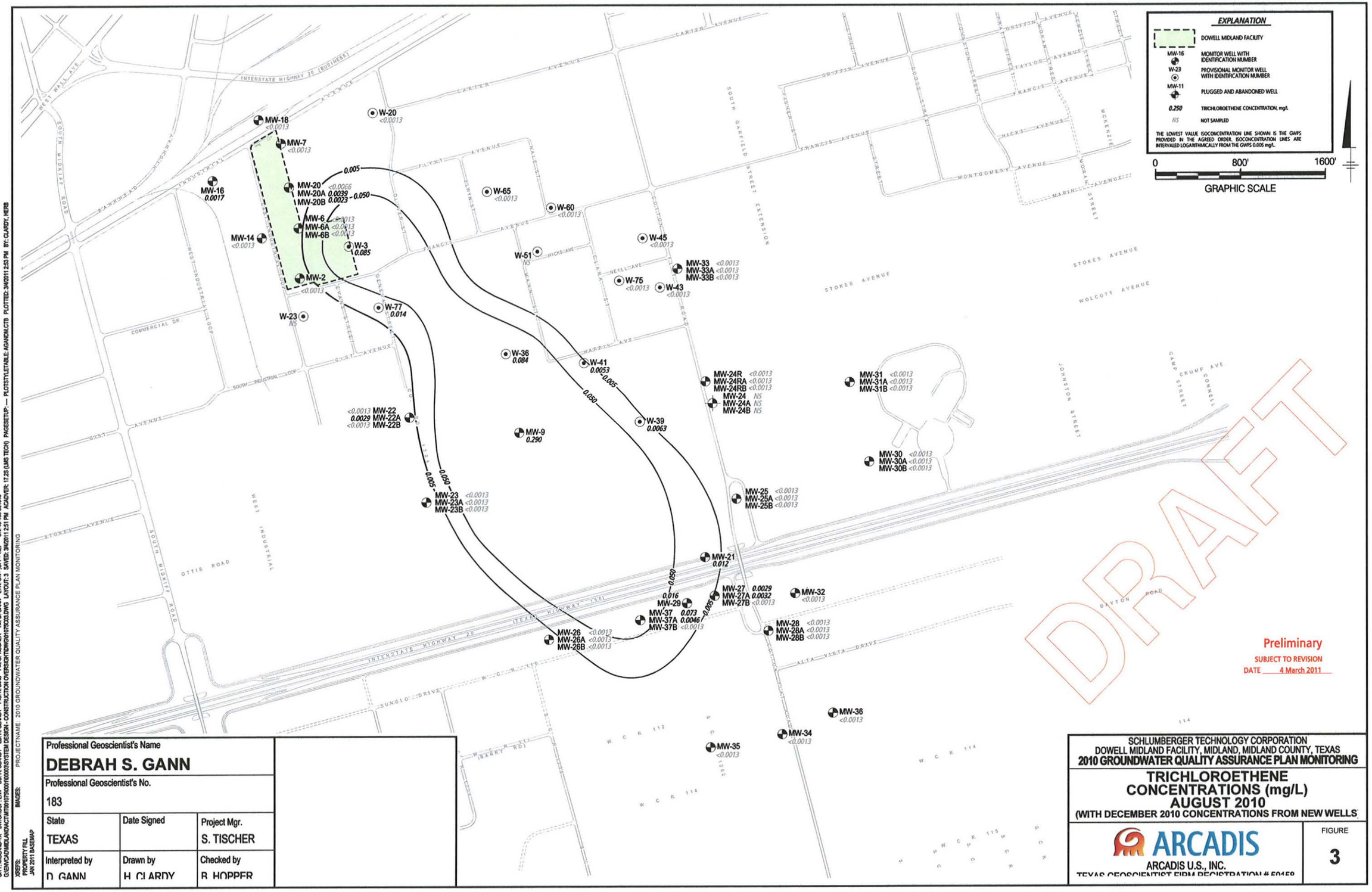
SCHLUMBERGER TECHNOLOGY CORPORATION
DOWELL MIDLAND FACILITY, MIDLAND, MIDLAND COUNTY, TEXAS
2010 GROUNDWATER QUALITY ASSURANCE PLAN MONITORING

TETRACHLOROETHENE CONCENTRATIONS (mg/L) AUGUST 2010

(WITH DECEMBER 2010 CONCENTRATIONS FROM NEW WELLS)

ARCADIS
ARCADIS U.S., INC.
TEXAS GEOSCIENTIST FIRM REGISTRATION # 50158

FIGURE
2



Professional Geoscientist's Name		
DEBRAH S. GANN		
Professional Geoscientist's No.		
183		
State	Date Signed	Project Mgr.
TEXAS		S. TISCHER
Interpreted by	Drawn by	Checked by
D. GANN	H. CLARDY	R. HOPPER

SCHLUMBERGER TECHNOLOGY CORPORATION
DOWELL MIDLAND FACILITY, MIDLAND, MIDLAND COUNTY, TEXAS
2010 GROUNDWATER QUALITY ASSURANCE PLAN MONITORING

TRICHLOROETHENE CONCENTRATIONS (mg/L) AUGUST 2010

(WITH DECEMBER 2010 CONCENTRATIONS FROM NEW WELLS)

ARCADIS
ARCADIS U.S., INC.
TEXAS GEOSCIENTIST FIRM REGISTRATION # 50158

FIGURE
3

CITY: MIDLAND-TX DIV/GROUP: ENV DB: H. CLARDY LD: H. CLARDY PIC: K. DIAS PM: S. TISCHER TM: D. GANN LYR: ON=*;OFF=*REF* UN: 43-105-001346
G:\ENV\CAD\MIDLAND\ACTIVITY\60197500010000\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\60197520S.DWG LAYOUT: 3 SAVED: 3/4/2011 2:51 PM ACADVER: 17.2S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: AGANDM.CTB PLOTTED: 3/4/2011 2:53 PM BY: CLARDY, HERB

XREFS:
PROPERTY FILL
JAN 2011 BASEMAP

IMAGES:

PROJECTNAME: 2010 GROUNDWATER QUALITY ASSURANCE PLAN MONITORING

ARCADIS
Infrastructure · Water · Environment · Buildings

ARCADIS U.S., Inc.
1004 North Big Spring Street
Suite 300
Midland
Texas 79701
Tel 432.687.5400
Fax 432.687.5401

ARCADIS U.S., Inc.
TX Engineering License # F-533

MEMO

To:
Schlumberger Midland Project Team

Copies:

From:
John Perella & Peter Palmer

Date:
February 10, 2011

ARCADIS Project No.:
MT001076.0001

Subject:
AS/SVE Pilot Test Work Plan

Introduction

The purpose of this Memo is to outline the Air Sparge and Soil Vapor Extraction (AS/SVE) pilot test, proposed for the Schlumberger Technology Corporation Midland, Texas Site (Site). The AS/SVE pilot test will be performed to evaluate the feasibility of this technology to address Chlorinated Volatile Organic Compound (CVOC) impacts identified in the groundwater southeast of the Site. Specifically, this pilot test will be performed in the vicinity of the MW-37 monitoring well cluster, which is located approximately 4,000' southeast of the Site and southwest of the interchange of Interstate Highway 20 and Cotton Flat Road.

Pilot testing will be performed in the shallow aquifer (and the vadose zone overlying it) which occurs from land surface to approximately 40 feet below land surface (bls) and is composed of caliche, sand and interbedded sandstone layers. The shallow aquifer water table is located at approximately 18 feet bls. The shallow zone is separated from a deeper permeable zone by an approximate 20 foot layer of siltstone located from 40 to 60 feet bls. The deep zone is from approximately 60 to 85 feet bls and is composed of a sandstone layer above a layer of gravel. Air sparging will be pilot tested in the shallow zone only, since evaluation of Site data indicates that the deep zone is not impacted in this area and is unlikely to be impacted in the future. Soil

vapor extraction pilot testing will be performed in the vadose zone which extends from the land surface to the water table (approximately 18 feet bls).

Pilot Test Objectives

The objective of the AS/SVE pilot test is to demonstrate that air sparging and soil vapor extraction is a viable treatment technology for the remediation of dissolved phase-chlorinated hydrocarbons, specifically to address 1,1-dichloroethylene (1,1-DCE) migrating off the Site in shallow groundwater to the southeast. The pilot test will be performed to determine design parameters such as flow rate, injection pressure, extraction pressure and radii of influence (ROI) for the utilization in the design of a full scale system.

Pilot Test Wells

The pilot test will utilize a total of 2 monitoring wells, 3 piezometers, 1 air sparge well and 1 soil vapor extraction well. The 2 monitoring wells will be from the existing MW-37 monitoring well cluster. All other wells will be new construction and will be installed as detailed in **Table 1** and located as shown on **Figure 1.**

A single shallow air sparge well (SAS-1) will be installed approximately 10 feet east of MW-37. The shallow sparge well will be constructed of approximately 38-feet of 2-inch Schedule 40 PVC casing and a 2-foot section of 0.010" Vee-wire PVC well screen. Actual completion depth of the sparge well will be determined based on field conditions, i.e. the well will be completed on the top of the siltstone layer, approximately 40 feet bls.

Three piezometers (SPZ-1, SPZ-2 and SPZ-3) will be utilized during the shallow air sparge pilot testing phase, along with both MW-37 and MW-37A and the soil vapor extraction test well (SVE-1). The new piezometers will be constructed of 10 feet of 2-inch Schedule 40 PVC casing and 0.010" Vee-wire PVC well screen, screened from approximately 10 feet bls to 40 feet bls. The actual completion of the casing will be determined in the field based on the transition of the surface layer of caliche to sandstone, specifically, the solid casing shall be completed in the caliche layer but within 2 feet of the transition to sandstone, for the purpose of this work plan the solid casing is described as being completed approximately 10 feet bls. Further, the piezometer screens will be completed at the top of the siltstone layer, approximately 40 feet bls to assure coverage of the entire shallow aquifer and vadose zone. SPZ-

1 will be installed approximately 25 feet west of MW-37 (25 feet west of SAS-1). SPZ-2 and SPZ-3 will be installed approximately 15 feet and 25 feet east of SAS-1, respectively. SVE-1 will be installed approximately 5 feet east of SAS-1. Therefore, shallow air sparge pilot testing will utilize monitoring wells spaced 5, 10, 15, 25 and 35 feet from the shallow sparge well, which will allow for the analysis of the ROI of SAS-1, both horizontally and vertically.

The soil vapor extraction test well (SVE-1) will be installed approximately 5 feet east of SAS-1. The SVE well will be constructed of approximately 10 feet of 4-inch Schedule 40 PVC casing and a 30-foot section of 0.010" Vee-wire PVC well screen. As described above the solid PVC casing will be completed with 2 feet of the caliche to sandstone transition. The well screen will be completed at the top of the siltstone layer, approximately 40 feet bls in order to provide an additional monitoring point for the air sparge test.

The three shallow piezometers (SPZ-1, SPZ-2 and SPZ-3) will be utilized during testing and will be located approximately 40, 10 and 20 feet, respectively, from SVE-1. In addition, MW-37, located approximately 15 feet west of SVE-1, will be utilized during testing. Therefore, SVE pilot testing will utilize monitoring wells spaced 10, 15, 20 and 40 feet from SVE-1, which will allow for the analysis of the ROI of SVE-1.

During the installation of the wells, lithologic soil samples will be collected in two-foot depth intervals to determine the lithologic setting in the pilot test area.

Pilot Test Configuration

The pilot test will be performed in 3 steps, Step 1 — shallow air sparge test, Step 2 — soil vapor extraction test and Step 3 — shallow air sparge and soil vapor extraction test. All steps will be operated for a minimum of 8 hours each. The air sparge test may be conducted for up to 24 hours if necessary to obtain the required test data.

A rental compressor capable of providing oil free dry air at a continuous flow rate of 12 scfm and 30 psi will be utilized for the air sparge testing. A needle valve, pressure regulator, pressure gauge and flow meter will be installed on the compressor so that the flow rate may be adjusted and controlled. Pneumatic $^{1}/_{2}$-inch hose with minimum 100 psi operating pressure will be used to connect from the air compressor to the respective sparge well. Connection of hose to sparge well will be completed as detailed in **Figure 2.** A pressure gauge will be installed at the sparge well head.

A rental blower capable of producing a continuous flow rate of 80 scfm at 10 in-Hg vacuum will be utilized for the SVE testing. A gate valve, bypass gate valve, vacuum gauge and flow meter will be installed on the blower so that the flow rate may be adjusted and controlled. Reinforced vacuum rated 2-inch hose will be used to connect from the blower to the SVE well. Connection of hose to the SVE well will be completed as detailed in **Figure 3.** A vacuum gauge will be installed at the SVE well head.

Baseline Measurements

Prior to the initiation of the pilot testing, baseline sampling will be performed at all wells utilized for the pilot test (MW-37, MW-37A, MW-37B, SAS-1, SPZ-1, SPZ-2, SPZ-2, and SVE-1). Well head gauge pressure, depth-to-water (DTW), visual observations, dissolved oxygen (DO) and headspace measurements collected for 1,1 DCE using a Draeger Tube (DT). In addition, an air sample will be collected from SVE-1 using a summa canister. The sample will be analyzed for total VOCs and CVOCs.

Maximum Air Sparge Well Pressure

To avoid potentially fracturing the formation with excessive air pressure during testing, the maximum allowable sparge well pressure will be limited to 50% of the calculated vertical stress at the discharge point of the sparge well. The calculation for maximum sparge well pressure is provided in **Table 2.** Maximum sparge well pressure is 17 psi for SAS-1.

Maximum SVE Well Vacuum

To avoid raising the groundwater excessively into the vadose zone and limiting moisture in the extracted vapor, the maximum allowable SVE well vacuum will be limited to 7.5 feet of water or 8.5 in-Hg. This vacuum is equivalent to approximately half the length of the assumed non-submerged SVE well screen. Based on field conditions the maximum allowable SVE well vacuum may be reduced.

Step 1 - Shallow Air Sparge Test

The shallow air sparge test will be performed at varying flow rates between 2 and 8 scfm (or higher). To initiate the test, the needle valve on the compressor will be slowly opened until the breakthrough pressure is achieved. Breakthrough pressure is the required pressure to push the static water in the well out through the well screen. In the case of SAS-1 the breakthrough pressure will be approximately 9 psi at the

well head. Once break through has occurred, the flow rate will be adjusted until the flow meter reads 2 scfm. This initial flow rate will be maintained for at least 2 hours, during which time field readings for well head gauge pressure, flow, DTW, DT and DO will be collected, from SPZ-1, SPZ-2, SPZ-3, SVE-1, MW-37 and MW-37A. DO measurements will be collected from the bottom, middle, and top portion of the well screen. Well head gauge pressure will also be collected from the sparge well. Field measurements for well head gauge pressure and flow will be collected and recorded every 30 minutes, DTW will be collected hourly, and DT and DO measurements will be collected after the first 30 minutes of operation.

At the completion of the initial operation the flow rate will be adjusted based on field conditions, however the maximum sparge well pressure may not be exceeded and as the flow rate is adjusted it should be maintained for a minimum of 2 hours. During each additional 2-hour step, field data will collected at 30 minute intervals for well head gauge pressure and flow. DTW, DT and DO field data will be collected at the end of each 2-hour test interval. For the purposes of this work plan, flow rates should be adjusted in a 2 scfm stepwise fashion, i.e. 2, 4, 6 and 8 scfm, however these flow rates may be adjusted based on field conditions. The shallow sparge well pilot test will operate for a minimum of 8 hours, but may be operated for up to 24 hours depending on the results. A sample shallow air sparge pilot test field log is provided as **Table 3.**

Step 2 - SVE Test

The SVE test will be performed at varying flow rates between 10 and 70 scfm. To initiate the test, the SVE blower will be turned on with the gate valve partially open and the flow rate will be adjusted until 10 scfm is achieved. The bypass gate valve may have to be opened to assure the blower is operating within its design range. The initial flow rate will be maintained for at least 2 hours, during which time field readings for well head gauge pressure and flow will be collected, from SPZ-1, SPZ-2, SPZ-3 and MW-37. Within approximately 15 minutes of the initiation of the SVE test, a DT sample will be collected. In addition, an air sample will be collected using a summa canister. The sample will be analyzed for VOCs and SVOCs. Field measurements for well head gauge pressure and flow will be collected every 30 minutes for the duration of the test.

At the completion of the initial operation the flow rate will be adjusted based on field conditions, however the maximum SVE well pressure may not be exceeded and as the flow rate is adjusted it should be maintained for a minimum of 2 hours. For the purposes of this work plan, flow rates should be adjusted in a 20 scfm stepwise fashion, i.e. 10, 30, 50 and 70 scfm, however these flow rates may be adjusted based on field conditions. The SVE well pilot test will operate for a minimum of 8 hours. At the end of the

SVE test, a DT sample and DTW measurements will be collected. A sample SVE field log is provided as **Table 4.**

Step 3 — AS/SVE Test

The AS/SVE test will be performed at what will be considered the optimal flow rates achieved during the shallow air sparge and SVE pilot tests. Optimal flow rate for the shallow sparge pilot test is the flow rate at which the maximum ROI is achieved and the maximum sparge well pressure is not exceeded, likewise the optimal flow rate for the SVE pilot test is the flow rate at which the maximum ROI is achieved and the maximum SVE vacuum is not exceeded. To initiate the test, the SVE blower will be turned on with the gate valve partially open and the flow rate will be adjusted until optimal SVE flow rate is achieved. The sparge compressor will then be turned on and also adjusted to its optimal flow rate. This flow rate will be maintained for the duration of the test but may be adjusted based on field conditions. Field readings for well head gauge pressure, flow rates, DTW, DT and DO will be collected, from SPZ-1, SPZ-2, SPZ-3, MW-37 and MW-37A. DO measurements will be collected from the bottom, middle, and top portion of the well screen. Approximately 15 minutes into the AS/SVE test, a DT sample will be collected. In addition, an air sample will be collected using a summa canister. The sample will be analyzed for VOCs and SVOCs. Field measurements for well head gauge pressure and flow will be collected and recorded every 30 minutes, DTW, DT and DO measurements will be collected after the first four hours of operation and at the end of the test. The AS/SVE well pilot test will operate for a minimum of 8 hours. A sample AS/SVE field log is provided as **Table 5.**

Table 1
Pilot Test Well Details

Schlumberger Technology Corporation
Midland, Texas
Air Sparge / Soil Vapor Extraction Pilot Test

Well ID	Status	Well Screen Interval (ft-bls)	Well Screen Slot size	Well Diameter (inches)	Corresponding Test Well	Distance from Test Well (ft)
MW-37	Existing	16 - 36	0.010"	2	SAS-1, SVE-1	10, 15
MW-37A	Existing	45 - 55	0.010"	2	SAS-1	10
MW-37B	Existing	65 - 85	0.010"	2	NA	NA
SAS-1	Proposed	38 - 40	0.010"	2	NA	NA
SVE-1	Proposed	10 - 40	0.010"	4	NA	NA
SPZ-1	Proposed	10 - 40	0.010"	2	SAS-1, SVE-1	35, 40
SPZ-2	Proposed	10 - 40	0.010"	2	SAS-1, SVE-1	15, 10
SPZ-3	Proposed	10 - 40	0.010"	2	SAS-1, SVE-1	25, 20

Table 2
Calculation of Maximum Allowable Pressure at Sparge Point

Schlumberger Technology Corporation
Midland, Texas
Air Sparge / Soil Vapor Extraction Pilot Test

	Shallow	
Height of water column (ft)	20.0	= Assume Static Water Level 18' below land surface
Breakthrough pressure (psi)	8.7	= Density of water (62.4 lb/ft^3) * Height of water
Height of soil column (ft)	38.0	= Depth to top of screen of sparge point
Pressure of soil (psi)	26.4	= Density of Soil (100 lb/ft^3) * Height of soil
Vertical Stress at Discharge Point (psi)	17.7	= Pressure of soil - Breakthrough pressure
Max. Allowable Horizontal Stress at Discharge Point (psi)	8.9	= 0.5 * Vertical Stress
Max Pressure at Well Head (psi)	17.5	= Max Horizontal Stress + Breakthrough Pressure

Table 3
Shallow Air Sparge Pilot Test Log Sheet

Schlumberger Technology Corporation
Midland, Texas
Air Sparge / Soil Vapor Extraction Pilot Test

Date							
Time						Sheet	1 /
Well ID	Pressure (in-H20)	Water Level (ft)	Visual (Y/N)	Bottom DO (mg/L)	Middle DO (mg/L)	Top DO (mg/L)	DT (ppm, 1,1-DCE)
Shallow Wells							
MW-37							
MW-37A							
SPZ-1							
SPZ-2							
SPZ-3							
SVE-1							

Sparge Well	Pressure (psi)	Flow rate (SCFM)	Pulse (Y/N)	Pulse (Time On / Time Off)
SAS-1				

Comments:

Table 4
Soil Vapor Extraction Pilot Test Log Sheet

Schlumberger Technology Corporation
Midland, Texas
Air Sparge / Soil Vapor Extraction Pilot Test

Date			
Time		Sheet	1 /
Well ID	Vacuum (in-H20)	Water Level (ft)	DT (ppm, 1,1-DCE)
Shallow Wells			
MW-37			
SPZ-1			
SPZ-2			
SPZ-3			
SVE Well	Vacuum (in-H2O)	Flow rate (SCFM)	
SVE-1			

Comments:

Table 5
Shallow Air Sparge and SVE Pilot Test Log Sheet

Schlumberger Technology Corporation
Midland, Texas
Air Sparge / Soil Vapor Extraction Pilot Test

Date							
Time						Sheet	1 /
Well ID	Pressure (in-H20)*	Water Level (ft)	Visual (Y/N)	Bottom DO (mg/L)	Middle DO (mg/L)	Top DO (mg/L)	DT (ppm, 1,1-DCE)
Shallow Wells							
MW-37							
MW-37A							
SPZ-1							
SPZ-2							
SPZ-3							

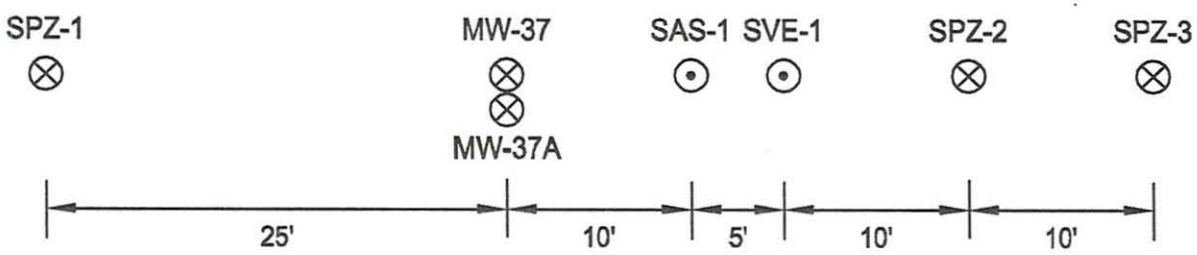
Sparge Well	Pressure (psi)	Flow rate (SCFM)	Pulse (Y/N)	Pulse (Time On / Time Off)
SAS-1				

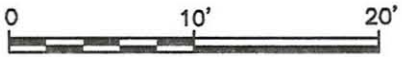
SVE Well	Vacuum (in-H2O)	Flow rate (SCFM)
SVE-1		

Comments:

Notes:
* Pressure may be positive or negative during testing.

CITY: MIDLAND, TX DIV/GROUP: ENV DB: H. CLARDY LD: H. CLARDY PIC: K. DIAS PM: S. TISCHER TM: D. GANN LYR: ON=*;OFF=*REF* UN: 43-165-01334
G:\ENVCAD\MIDLAND\ACT\MT001075\0001\00003\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\01075B01.DWG LAYOUT: 1 SAVED: 2/16/2011 11:11 AM ACADVER: 17.2S (LMS TECH) PAGESETUP: ACROPLOT PDF PLOTSTYLETABLE: ACAD.CTB PLOTTED: 2/16/2011 11:11 AM BY:
CLARDY, HERB
XREFS: IMAGES: PROJECTNAME: AIR SPARGE/SOIL VAPOR EXTRACTION PILOT TEST





SCHLUMBERGER TECHNOLOGY CORPORATION
MIDLAND, TEXAS

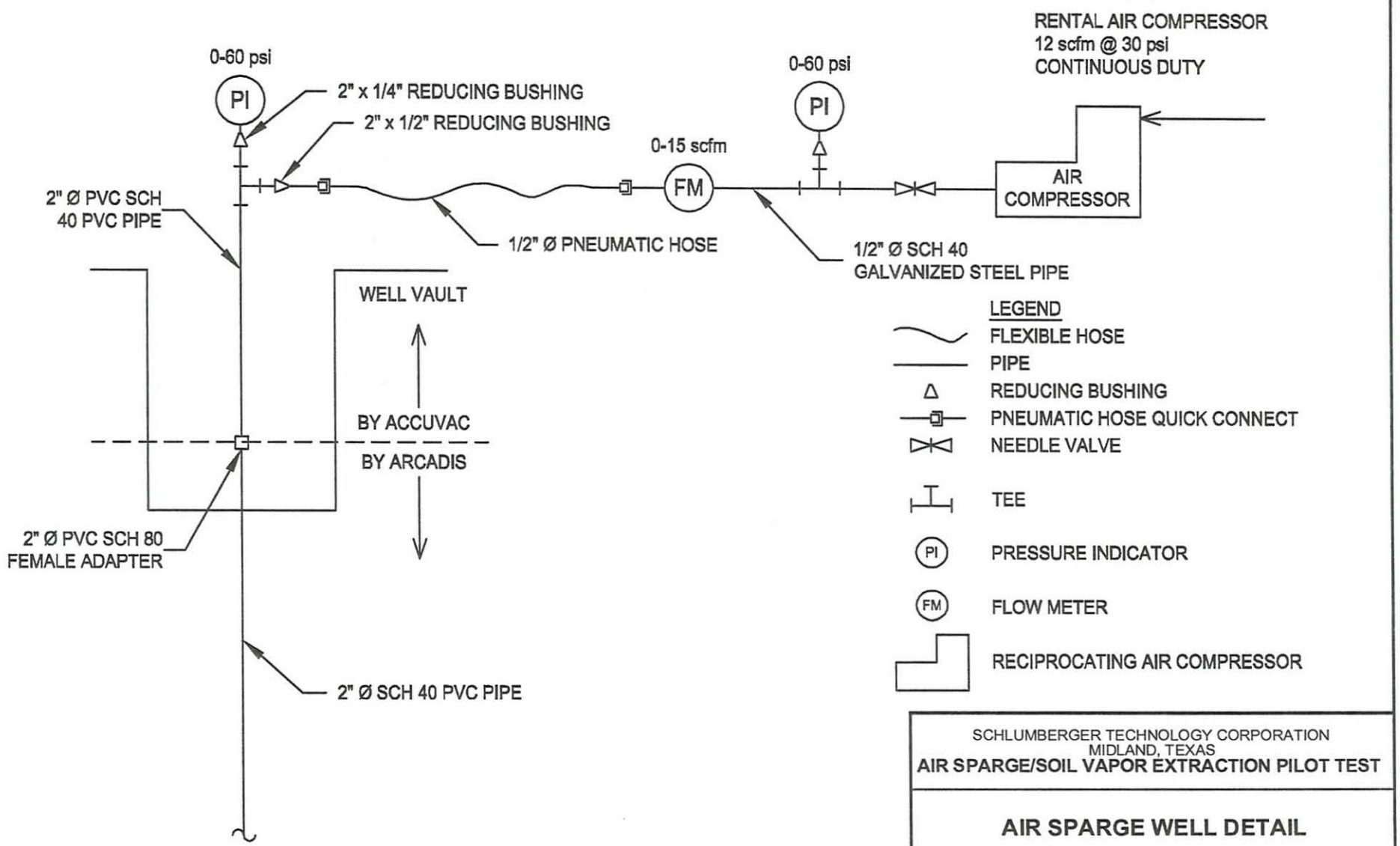
AIR SPARGE/SOIL VAPOR EXTRACTION PILOT TEST

WELL LAYOUT

ARCADIS

FIGURE
1

CITY: MIDLAND, TX DIV/GROUP: ENV DB: H. CLARDY LD: H. CLARDY PIC: K. DIAS PM: S. TISCHER TM: D. GANN LYR: ON=*;OFF=*REF* UN: 43-165-01335
G:\ENVCAD\MIDLAND\ACT\MT001075\0001\00003\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\01075D01.DWG LAYOUT: 2 SAVED: 2/16/2011 11:18 AM ACADVER: 17.2S (LMS TECH) PAGESETUP: ACROPLOT PDF PLOTSTYLETABLE: ACAD.CTB PLOTTED: 2/16/2011 11:18 AM BY: CLARDY, HERB
XREFS: IMAGES: PROJECTNAME: AIR SPARGE/SOIL VAPOR EXTRACTION PILOT TEST



NOT TO SCALE

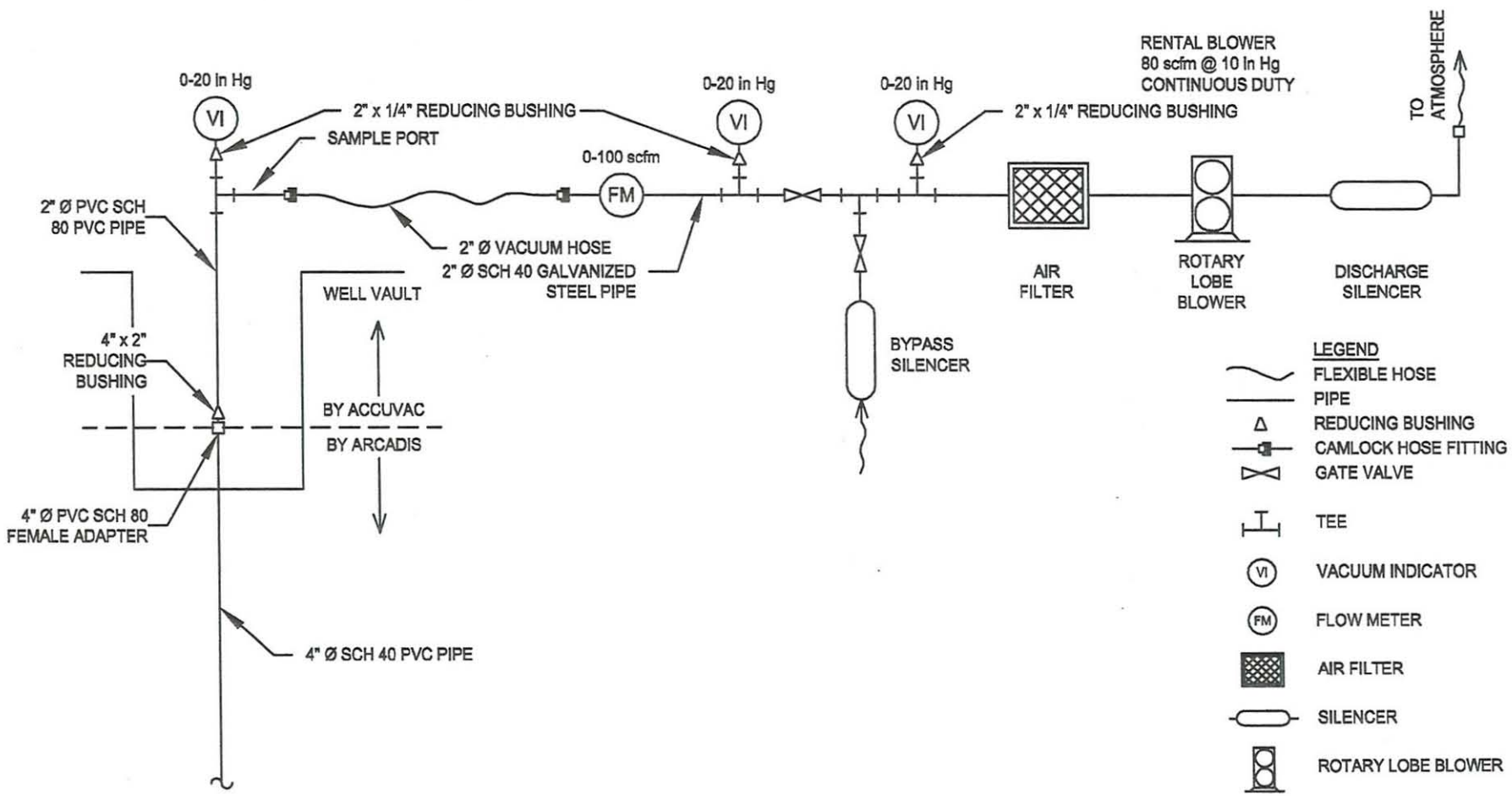
SCHLUMBERGER TECHNOLOGY CORPORATION
MIDLAND, TEXAS
AIR SPARGE/SOIL VAPOR EXTRACTION PILOT TEST

AIR SPARGE WELL DETAIL

ARCADIS

FIGURE
2

CITY: MIDLAND, TX DIV/GROUP: ENV DB: H. CLARDY LD: H. CLARDY PIC: K. DIAS PM: S. TISCHER TM: D. GANN LYR: ON=*;OFF=*REF* UN: 43-165-01335
G:\ENVCAD\MIDLAND\ACT\MT001075\0001\00003\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\01075D02.DWG LAYOUT: 3 SAVED: 2/16/2011 11:24 AM ACADVER: 17.2S (LMS TECH) PAGESETUP: ACROPLOT.PDF PLOTSTYLETABLE: ACAD.CTB PLOTTED: 2/16/2011 11:25 AM BY: CLARDY, HERB
XREFS: IMAGES: PROJECTNAME: AIR SPARGE/SOIL VAPOR EXTRACTION PILOT TEST



NOT TO SCALE

SCHLUMBERGER TECHNOLOGY CORPORATION
MIDLAND, TEXAS

AIR SPARGE/SOIL VAPOR EXTRACTION PILOT TEST

SOIL VAPOR EXTRACTION WELL DETAIL

ARCADIS

FIGURE 3

ARCADIS
Infrastructure, environment, facilities

Imagine the result

Schlumberger Technology Corporation

DRILL WELLS FOR AIR SPARGE AND SOIL VAPOR EXTRACTION PILOT TEST WORK PLAN

Dowell Midland Facility,
SWR #33591, RN #102157252,
CN #600384481

Midland, Midland County, Texas

ARCADIS

Debrah S. Gann, P.G.
Task Manager 2

Alan J. Reed, Jr., P.E.
Senior Engineer

David Vance
Principal Scientist

Steven P. Tischer, P.G.
Associate Vice President

Drill Additional Wells for VOC Delineation Work Plan

Midland, Midland County, Texas

Prepared for:
Schlumberger Technology Corporation

Prepared by:
ARCADIS U.S., Inc.
1004 North Big Spring Street
Suite 300
Midland
Texas 79701
Tel 432.687.5400
Fax 432.687.5401

Our Ref.:
MT001075.0001.00004

Date:
February 18, 2011

Figures

1.0 INTRODUCTION

The Dowell Midland Facility is located in south-central Midland, Midland County, Texas (Figure 1). This document outlines a work plan for the installation of air sparge, piezometer and soil vapor extraction wells southeast of the Dowell Midland Facility.

2.0 SITE BACKGROUND

An Agreed Order (AO) between the Texas Commission on Environmental Quality (TCEQ) and Dowell, a division of Schlumberger Technology Corporation, for the Dowell Midland Facility was signed on July 13, 1994. In general, the AO required delineation, monitoring and remediation of VOCs and other contaminants of concern in the soil and groundwater that originated from the Dowell Midland Facility. The Dowell Midland Facility has complied with the AO requirements since it was signed.

In December 2010, 6 new groundwater monitoring wells were drilled, under the supervision of ARCADIS, to further delineate VOCs (see Figure 2 for locations relative to existing monitor well MW-37). Groundwater samples collected for each of the new wells indicated a 1,1-Dichloroethene (1,1-DCE) concentration of 110 micrograms per liter (µg/L) in MW-37 and 5.7 µg/L in MW-37A. The maximum contaminant level (MCL) of 1,1-DCE is 7 µg/L established by the U.S. Environmental Protection Agency (USEPA). MW-37 also contained 26 µg/L of Tetrachloroethene (PCE) and 73 µg/L of Trichloroethene (TCE); both over the MCL as established by the USEPA of 5 µg/L.

The results for MW-34, MW-35, MW-36 and MW-37B are *not detected* for all VOCs. For MW-37 and MW-37A, 1,1-dichloroethene (1,1-DCE) is 0.110 mg/L and 0.0057 mg/L, tetrachloroethene (PCE) is 0.026 mg/L and not detected, and trichloroethene (TCE) is 0.073 mg/L and 0.0046 mg/L, respectively.

In August 2010, 11 new groundwater monitoring wells were drilled, under the supervision of ARCADIS, to further delineate VOCs (MW-29, MW-30, MW-30A, MW-30B, MW-31, MW-31A, MW-31B, MW-32, MW-33, MW-33A and MW-33B; MW-24R, MW-24RA, MW-24RB were drilled to replace MW-24, MW-24A and MW-24B). In December 2010, 6 new groundwater monitoring wells were drilled to complete the delineation of VOCs (MW-34, MW-35, MW-36, MW-37, MW-37A and MW-37B). Groundwater samples collected from these 6 new wells in December 2010 indicated a 1,1-Dichloroethene (1,1-DCE) concentration of 110 micrograms per liter (µg/L) in MW-37 and 5.7 µg/L in MW-37A. The maximum contaminant level (MCL) of 1,1-Dichloroethene

is 7 µg/L established by the U.S. Environmental Protection Agency (USEPA). MW-37 also contained 73 µg/L of Tetrachloroethene (PCE) and 26 µg/L of Trichloroethene (TCE); both over the MCL as established by the USEPA of 5 µg/L. MW-37A detected 4.6 µg/L of TCE, which is slightly below MCL. The VOC data suggests a distal end to the VOC plume associated with the Dowell Midland Facility to the southeast and east.

3.0 PURPOSE

Because observations in monitoring wells MW-34, MW-35 and MW-36 are Non Detected for VOCs, it is proposed to install an air sparge/soil vapor extraction (AS/SVE) pilot test at the MW-37 location. The AS/SVE work plan describes the proposed location and well construction.

4.0 SITE SETTING

The Dowell Midland Facility is located at 32 East Industrial Loop and lies southeast of the intersection of Industrial Avenue and East Industrial Loop in south-central Midland, Midland County, Texas. The area in the vicinity of the site generally consists of commercial/industrial property and some residential property that are dependent upon the available supply of groundwater. The topography in the area is very gently sloping to the southeast. Surface drainage is generally along the developed streets to the south and east. Drainage in the undeveloped areas is usually down slope to the southeast. Local drainage may be affected by the presence of surface depressions or playas. Several playas are present in the area. The following sections discuss the geology and hydrology of the shallow groundwater aquifer at the site.

4.1 Geology

The site is located in the Southern High Plains region of west Texas. Regionally, the geologic materials present at ground surface are windblown cover sands of Pleistocene (Quaternary) age. The cover sands are fine to medium grained silty sand, grayish-red to brown with caliche nodules. These cover sands range in thickness from zero to two feet.

The surface cover sands are underlain by a deposit of caliche generally 15 to 20 feet in thickness. The caliche is believed to form as the result of calcium carbonate and silica being leached from surface materials and re-deposited in the subsoils. Existing sediments are cemented into an amorphous mass of irregular thickness and hardness. In some cases (as in the vicinity of monitoring wells MW-16 and MW-17), very hard and dense caliche deposits are

found within inches of the ground surface. However, regionally, near surface deposits of caliche are characterized as chalky and friable with imbedded clays and sands. The more lithified caliche deposits are often fractured. The permeability and porosity of this horizon is a function of weathering near the surface which can locally widen the fractures in these deposits. These fractures are the main pathways for vertical migration of the contaminants through the near surface materials.

Underlying the caliche, in most areas, are 5 to 10 feet of purplish-brown to light gray siltstones, sandstones and clay lenses which are part of the Cretaceous Trinity Group which underlies much of the Southern High Plains south of Midland. In some areas, a deposit of red clay approximately 10 feet thick is encountered immediately underlying the caliche.

At a depth of approximately 25 to 30 feet below the ground surface, clean, fine grained sandstone is encountered in the Trinity. This horizon (also referred to as the Antlers Sand) can be up to 40 to 50 feet thick, and characterized as well sorted, cemented with calcite and generally firm but friable. The sandstone is generally uniform in character and constitutes the principal near surface aquifer for the area but some boring logs in the area show coarser sands and gravel in this horizon.

Triassic age red clay deposits (red beds) underlie the Cretaceous Trinity aquifer throughout the region. These red beds define the lower limit of potable groundwater in the area. In some parts of the Midland area, "false" red beds may be encountered. These localized deposits, generally ranging from 10 to 20 feet thick, can influence groundwater flow.

4.2 Hydrology

The direction of groundwater movement under undisturbed conditions in the shallow groundwater system is influenced by local topography, and is generally to the south-southeast. The local gradient is approximately 0.005 feet per foot, based on an aquifer pumping test performed on the Dowell Midland Facility in 1991. Recharge to the shallow groundwater system is primarily from precipitation on the outcrop or infiltration from depressions and playa lakes. Natural discharge of groundwater occurs primarily as evapotranspiration and secondarily as localized seepage in draws and drainages.

The Antlers Sand contains small to moderate amounts of fresh to slightly saline water in the area. The quality of the water is generally acceptable for public supply, although it may be locally high in total dissolved solids (TDS) or hardness. The TDS content in groundwater

samples collected from area wells generally range in value from <1,000 milligrams per liter (mg/L) to >3,000 mg/L. The near surface geology not only influences the direction of groundwater flow, but also may contribute to the variation in groundwater chemistry.

5.0 ADDITIONAL VOC PLUME DELINEATION

5.1 Groundwater Monitoring Well Construction

In order to progress with the remediation of the VOC plume associated with the Dowell Midland Facility, the installation of AS/SVE wells is proposed at the MW-37 location identified on Figure 1 of the AS/SVE Work Plan. It is anticipated that the depth to groundwater will range between approximately 15 and 20 feet below ground surface at the proposed AS/SVE well locations. Air sparge, piezometers and soil vapor extraction wells will be completed according to the specifications shown on Figures 3, 4 and 5.

Prior to initiating drilling activities, access agreements will be obtained from private landowners or public entities as applicable. Once agreements are in place, the proposed AS/SVE well locations will be staked and utilities cleared according to the Sampling and Analysis Plan (SAP) prepared for the Dowell Midland Facility in 1995. If agreements cannot be obtained for any of the proposed AS/SVE well locations, alternate locations may be selected that meet the delineation requirements.

AS/SVE well boreholes will be drilled utilizing a truck-mounted air rotary drilling rig. The borehole diameters are specified on Figures 3 through 5. Surface completions will be flush with ground level, with a traffic rated steel vault and manhole protecting the wellhead. A 4-foot square, 4-inch thick concrete pad will be installed around each piezometer wellhead. A locking cap will be installed on the top of each well to prevent unauthorized access. Each well will be permanently marked by its well number. A complete record of drilling and construction details will be completed for each of the new monitoring wells.

Each new AS/SVE well will be developed to optimize efficiency and remove fine sediments. Fluids will not be introduced to the boreholes during drilling. Therefore, removal of introduced fluids will not be a well development or groundwater quality concern. Well development will be accomplished by initially bailing the well until fines have been removed and water is clear. If it is determined that bailing will not develop the well in a timely manner, a submersible pump may be utilized to produce larger quantities of water to hasten well development. During well development, the gravel pack shall be monitored and if settling occurs, the gravel pack shall be

brought back up to the proper level above the screen. The bentonite seal on top of the gravel pack, the annulus cement grout, well vault and concrete slab shall not be placed until the well has been fully developed and the gravel pack has been brought up to the proper level above the screen.

All soil cuttings and water produced during drilling activities will be contained at the drill sites in a bermed, plastic-lined pit. Cuttings will be transferred to lined roll-off boxes for temporary storage. Likewise, produced water will also be containerized for storage prior to characterization for disposal. Composite samples of soils and water will be obtained as per the SAP and disposal will be arranged in a TCEQ-approved manner. All equipment involved directly with the drilling and completion of the monitoring wells will be decontaminated according to the requirements outlined in the SAP.

All of the new AS/SVE well locations will be surveyed at the conclusion of the AS/SVE well drilling program. The survey will be completed by a state of Texas licensed surveyor and will include horizontal coordinates and elevations for the top of the well casing and natural ground level.

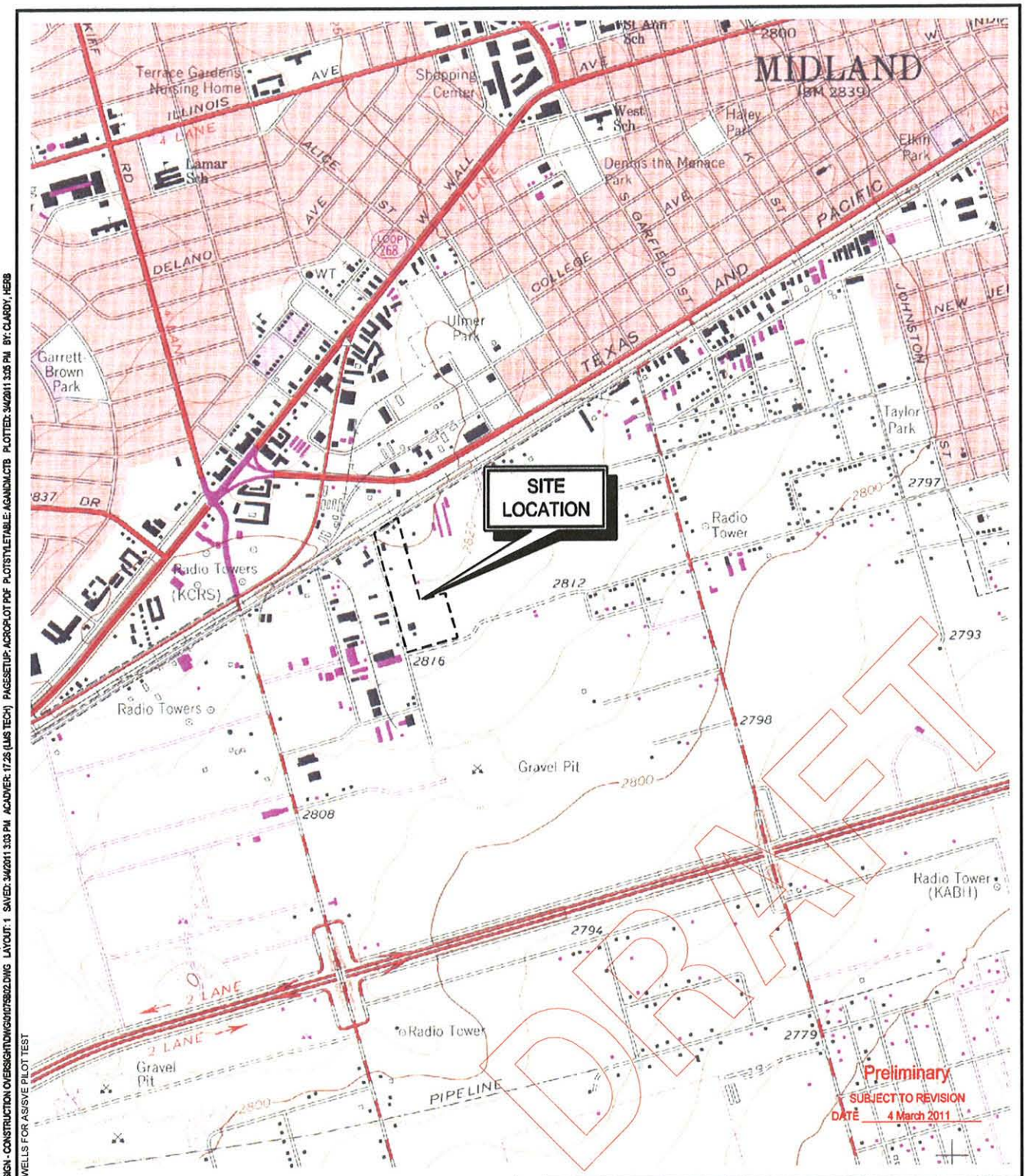
5.2 AS/SVE Well Sampling

Depth to groundwater measurements will be collected approximately 24 hours after the development and completion of each new monitoring well. Each new monitoring well will also be sampled for VOCs by USEPA Method 8260, total petroleum hydrocarbons (TPH), TDS, dissolved anions including chloride, sulfate, carbonate and bicarbonate, dissolved metals including arsenic, nickel, chromium, calcium, magnesium, sodium and potassium, total chromium, hexavalent chromium, pH and conductivity. All water level measurements, groundwater purging and sampling methods, sample labeling, preservation, shipping, chain of custody protocols and analytical methods will follow the requirements specified in the SAP and the Dowell Midland Facility Quality Assurance Plan (QAP).

6.0 References

Geraghty & Miller, Inc., Quality Assurance Quality Control Plan, Work Plan for the Soil and Groundwater Investigation at the Dowell Schlumberger Incorporated Facility, Midland, Texas, December 1994

Geraghty & Miller, Inc., Sampling and Analytical Plan, Amended Work Plan for the Soil and Groundwater Investigation at the Dowell Schlumberger Incorporated Facility, Midland, Texas, May 1995



0 2000' 4000'

GRAPHIC SCALE

SOURCE: PORTION OF U.S. GEOLOGICAL SURVEY 7½ MINUTE TOPOGRAPHIC QUADRANGLE, SOUTHEAST MIDLAND, TEXAS SHEET, PUBLISHED 1965, PHOTOREVISED 1974.

SCHLUMBERGER TECHNOLOGY CORPORATION
DOWELL MIDLAND FACILITY, MIDLAND, MIDLAND COUNTY, TEXAS
DRILL WELLS FOR AS/SVE PILOT TEST

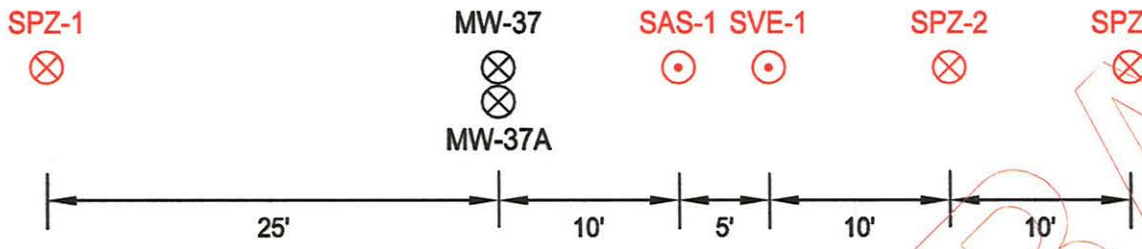
SITE LOCATION MAP

ARCADIS

FIGURE 1

CITY: MIDLAND, TX DIVGROUP: ENV DB: HCLARDY LD: HCLARDY PIC: PM: STISCHER TM: DGANN LYR: ON=*;OFF=*REF* UN: 43-165-001347
G:\ENV\CAD\MIDLAND\ACTIVITIES\001\075\000\010\000\035\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\010758022.DWG LAYOUT: 1 SAVED: 3/4/2011 3:03 PM ACADVER: 17.2S (LMS TECH) PAGESETUP: ACROPLOT.PDF PLOTSTYLETABLE: AGIANDM.CTB PLOTTED: 3/4/2011 3:05 PM BY: CLARDY, HERB
XREFS: IMAGES: PROJECTNAME: DRILL WELLS FOR AS/SVE PILOT TEST
DSMIDLAND.JPG

CITY: MIDLAND, TX DIV/GROUP: ENV DB: H. CLARDY LD: H. CLARDY PIC: K. DIAS PM: S. TISCHER TM: D. GANN LYR: ON=*;OFF=*REF* UN: 43-165-01349
G:\ENVCAD\MIDLAND\ACT\MT001075\0001\00003\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\01075B03.DWG LAYOUT: 2 SAVED: 3/9/2011 10:05 AM ACADVER: 17.2S (LMS TECH) PAGESETUP: ACROPLOT PDF PLOTSTYLETABLE: ACAD.CTB PLOTTED: 3/9/2011 10:05 AM BY: CLARDY, HERB
XREFS: IMAGES: PROJECTNAME: DRILL WELLS FOR AS/SVE PILOT TEST



Preliminary
SUBJECT TO REVISION
DATE 9 March 2011

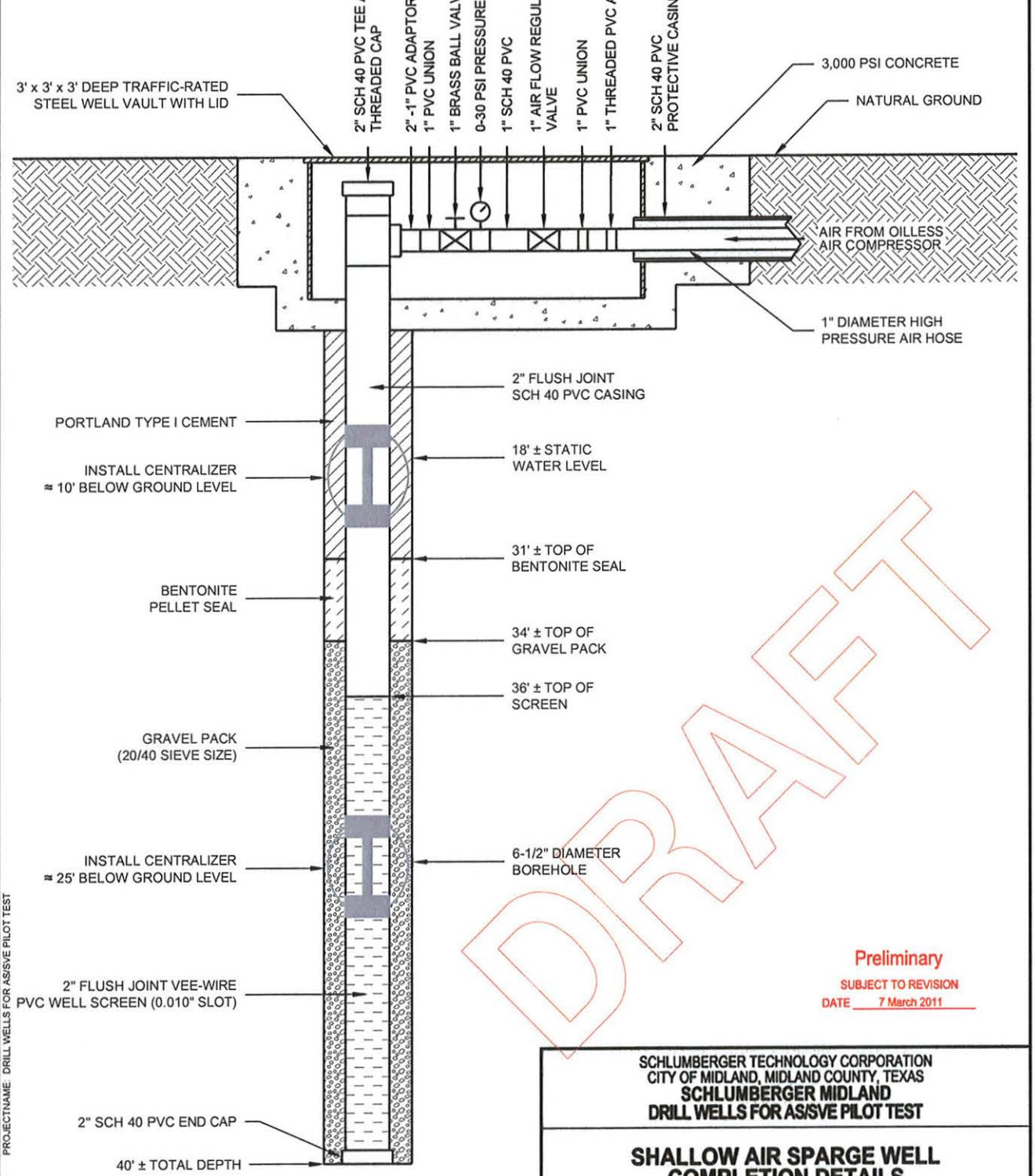
0 10' 20'
GRAPHIC SCALE

SCHLUMBERGER TECHNOLOGY CORPORATION
DOWELL MIDLAND FACILITY, MIDLAND, MIDLAND COUNTY, TEXAS
DRILL WELLS FOR AS/SVE PILOT TEST

PROPOSED AS/SVE WELL LOCATION MAP

ARCADIS

FIGURE
2



Preliminary

SUBJECT TO REVISION

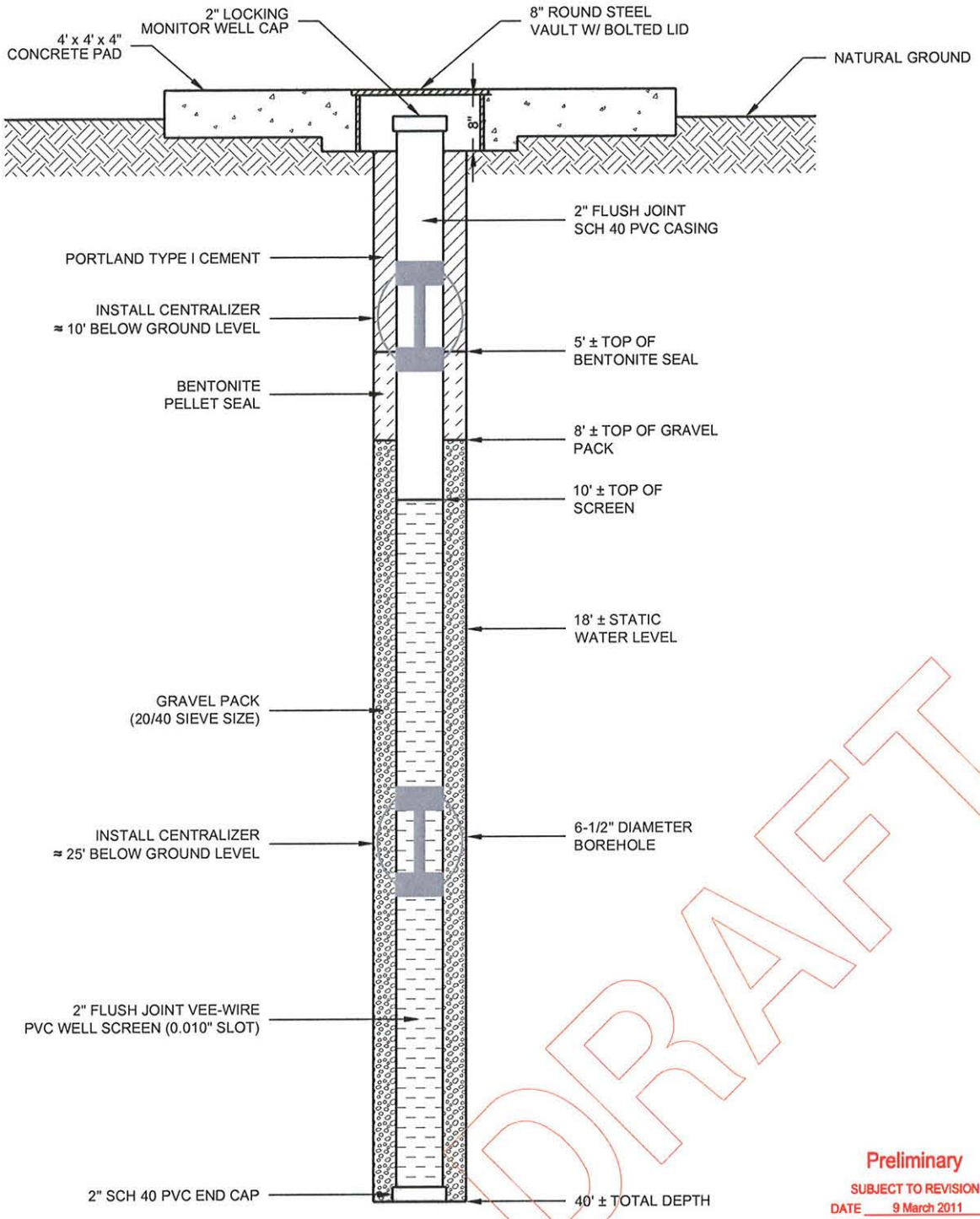
DATE 7 March 2011

SCHLUMBERGER TECHNOLOGY CORPORATION
CITY OF MIDLAND, MIDLAND COUNTY, TEXAS
SCHLUMBERGER MIDLAND
DRILL WELLS FOR AS/SVE PILOT TEST

SHALLOW AIR SPARGE WELL COMPLETION DETAILS

ARCADIS

FIGURE 3



Preliminary
SUBJECT TO REVISION
DATE 9 March 2011

DRAWING NOT TO SCALE

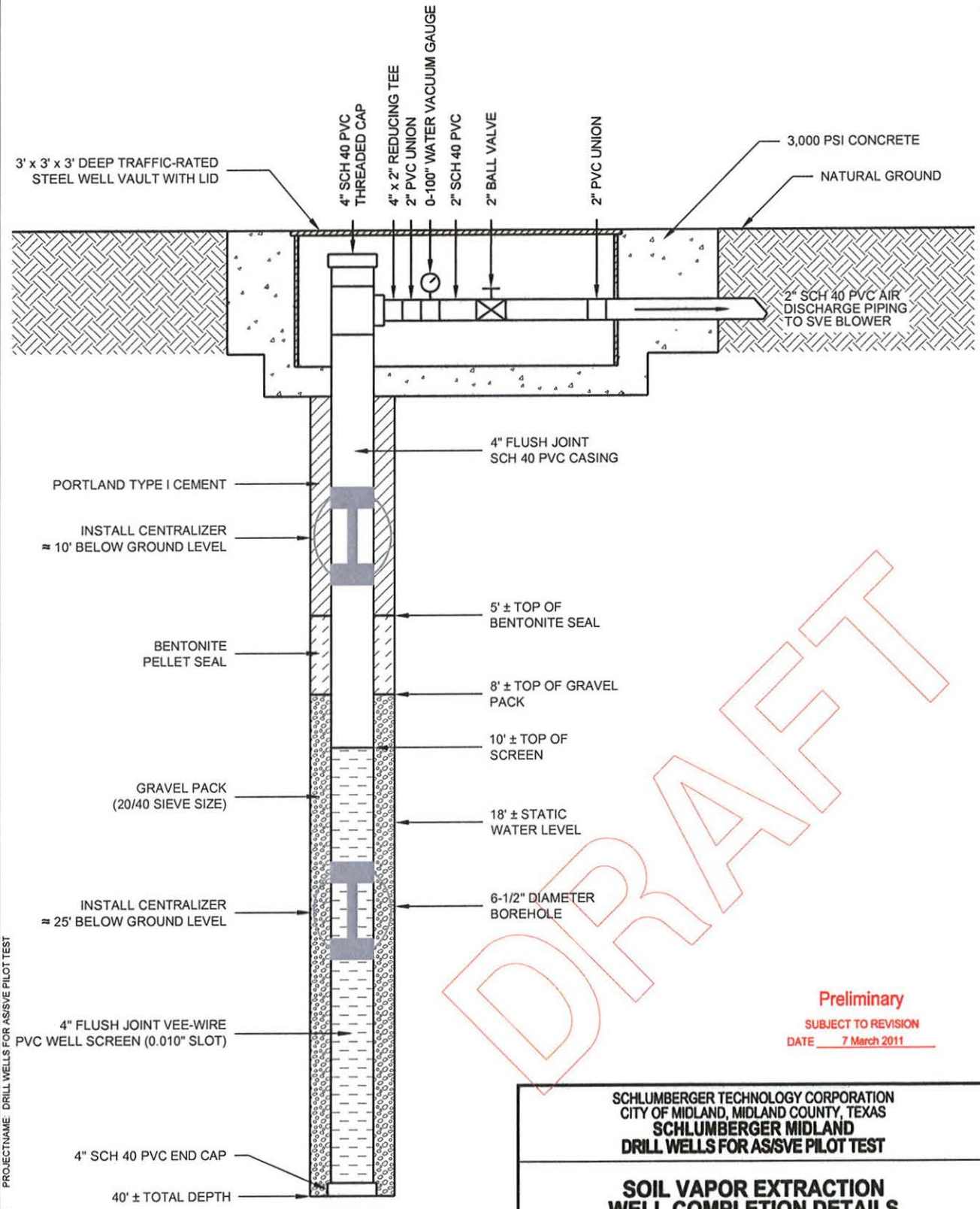
SCHLUMBERGER TECHNOLOGY CORPORATION
CITY OF MIDLAND, MIDLAND COUNTY, TEXAS
SCHLUMBERGER MIDLAND
DRILL WELLS FOR AS/SVE PILOT TEST

PIEZOMETER WELL COMPLETION DETAILS

ARCADIS

FIGURE
4

CITY: MIDLAND, TX DIV/GROUP: ENV DB: HCLARDY LD: HCLARDY PIC: PM: STISCHER TM: AREED LYR: ON=*;OFF=*REF* UN: 43-165-01351
G:\ENV\CAD\MIDLAND\ACT\MT00107500011\00003\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\01075N02.DWG LAYOUT: 4 SAVED: 3/9/2011 10:07 AM ACADVER: 17.2S (LMS TECH) PAGESETUP: PDF PLOTSTYLETABLE: ACAD.CTB PLOTTED: 3/9/2011 10:07 AM BY: CLARDY, HERB
XREFS: IMAGES: PROJECTNAME: DRILL WELLS FOR AS/SVE PILOT TEST



Preliminary
SUBJECT TO REVISION
DATE 7 March 2011

SCHLUMBERGER TECHNOLOGY CORPORATION
CITY OF MIDLAND, MIDLAND COUNTY, TEXAS
SCHLUMBERGER MIDLAND
DRILL WELLS FOR AS/SVE PILOT TEST

SOIL VAPOR EXTRACTION WELL COMPLETION DETAILS

ARCADIS

FIGURE
5

CITY: MIDLAND, TX DIV/GROUP: ENV DB: HCLARDY LD: HCLARDY PIC: PM: STISCHER TM: AREED LYR ON=*;OFF=*REF* UN: 43-165-01352
G:\ENVCAD\MIDLAND\ACTIVITY\0010750001\100003\SYSTEM DESIGN - CONSTRUCTION OVERSIGHT\DWG\0107SN03.DWG LAYOUT: 5 SAVED: 3/7/2011 12:02 PM ACADVER: 17.2S (LMS TECH) PAGESETUP: PDF PLOTSTYLETABLE: ACAD.CTB PLOTTED: 3/7/2011 12:02 PM BY: CLARDY, HERB
XREFS: IMAGES: PROJECTNAME: DRILL WELLS FOR AS/SVE PILOT TEST